

**AMENDMENTS TO THE CLAIMS**

Pursuant to 37 C.F.R. § 1.121 the following listing of claims will replace all prior versions, and listings, of claims in the application.

Claims 1-66 (Cancelled)

Claim 67 (Previously Presented): A decoder for producing a synthesized wideband signal, comprising:

a) a signal fragmenting device for receiving an encoded version of a wideband signal previously down-sampled during encoding and extracting from said encoded wideband signal version at least pitch codebook parameters, innovative codebook parameters, and linear prediction filter coefficients;

b) a pitch codebook responsive to said pitch codebook parameters for producing a pitch codevector;

c) an innovative codebook responsive to said innovative codebook parameters for producing an innovative codevector;

d) a combiner circuit for combining said pitch codevector and said innovative codevector to thereby produce an excitation signal;

e) a signal synthesis device including a linear prediction filter for filtering said excitation signal in relation to said linear prediction filter coefficients to thereby produce a synthesized wideband signal, and an oversampler responsive to said synthesized wideband signal for producing an over-sampled signal version of the synthesized wideband signal; and

f) a high-frequency content recovering device comprising:

i) a random noise generator for producing a noise sequence having a given spectrum;

ii) a spectral shaping unit for shaping the spectrum of the noise sequence in relation to linear prediction filter coefficients related to said down-sampled wideband signal; and

iii) a signal injection circuit for injecting said spectrally-shaped noise sequence in said over-sampled synthesized signal version to thereby produce said full-spectrum synthesized wideband signal.

Claim 68 (Previously Presented): A decoder for producing a synthesized wideband signal as defined in claim 67, wherein said random noise generator comprises a random white noise generator for producing a white noise sequence whereby said spectral shaping unit produces a spectrally-shaped white noise sequence.

Claim 69 (Currently Amended): A decoder for producing a synthesized wideband signal as defined in claim 68 [[8]], wherein said spectral shaping unit comprises:

a) a gain adjustment module, responsive to said white noise sequence and a set of gain adjusting parameters, for producing a scaled white noise sequence;

b) a spectral shaper for filtering said scaled white noise sequence in relation to a bandwidth expanded version of the linear prediction filter coefficients to produce a filtered scaled white noise sequence characterized by a frequency bandwidth generally higher than a frequency bandwidth of said over-sampled synthesized signal version; and

c) a band-pass filter responsive to said filtered scaled white noise sequence for producing a band-pass filtered scaled white noise sequence to be subsequently injected in said over-sampled synthesized signal version as said spectrally-shaped white noise sequence.

Claim 70 (Currently Amended): A decoder for producing a synthesized wideband signal as defined in claim 69, further comprising:

a) a voicing factor generator responsive to said ~~adaptive~~ pitch and innovative codevectors for calculating a voicing factor for forwarding to said gain adjustment module;

b) an energy computing module responsive to said excitation signal for calculating an excitation energy for forwarding to said gain adjustment module; and

c) a spectral tilt calculator responsive to said synthesized signal for calculating a tilt scaling factor for forwarding to said gain adjustment module;

wherein said set of gain adjusting parameters comprises said voicing factor, said excitation energy, and said tilt scaling factor.

Claim 71 (Currently Amended): A decoder for producing a synthesized wideband signal as defined in claim 70, wherein said voicing factor generator comprises a means for calculating said voicing factor  $rv$  using the relation:

~~$$r_v = (E_v - E_c) / (E_v + E_c)$$~~

where  $E_v$  is the in relation to an energy of a gain-scaled version of the pitch codevector and  $E_e$  is the an energy of a gain-scaled version of the innovative codevector.

Claim 72 (Currently Amended): A decoder for producing a synthesized wideband signal as defined in claim 70, wherein said gain adjustment module comprises a means for calculating an energy scaling factor using the relation:

$$\text{Energy scaling factor} = \sqrt{\frac{\sum_{n=0}^{N-1} u'^2(n)}{\sum_{n=0}^{N-1} w'^2(n)}}, \quad n=0, \dots, N-1,$$

where  $w'$  is said in relation to the white noise sequence,  $u'$  is and an enhanced excitation signal derived from said excitation signal,  $N'$  is a length of the white noise sequence and  $N$  is a subframe length.

**Claim 73 (Currently Amended):** A decoder for producing a synthesized wideband signal as defined in claim 70, wherein said spectral tilt calculator comprises a means for calculating said tilt scaling factor ~~at using the relation:~~

~~gt = 1 tilt bounded by  $0.2 \leq \text{gt} \leq 1.0$~~

~~where tilt is a tilt factor given by:~~

$$\text{tilt} = \frac{\sum_{n=1}^{N-1} s_h(n) s_h(n-1)}{\sum_{n=0}^{N-1} s_h^2(n)}$$

~~conditioned by  $\text{tilt} \geq 0$  et  $\text{tilt} \geq rv$ ,~~

~~wherein  $S_h$  is in relation to the synthesized signal,  $rv$  is and the voicing factor,  $N$  is a subframe length and  $n=0, \dots, N-1$ .~~

Claim 74 (Cancelled):

Claim 75 (Previously Presented): A decoder for producing a synthesized wideband signal as defined in claim 69, wherein said band-pass filter comprises a frequency bandwidth located between 5.6 kHz and 7.2 kHz.

Claim 76 (Previously Presented): A decoder for producing a synthesized wideband signal, comprising:

a) a signal fragmenting device for receiving an encoded version of a wideband signal previously down-sampled during encoding and extracting from said encoded wideband signal version at least pitch codebook parameters, innovative codebook parameters, and linear prediction filter coefficients;

b) a pitch codebook responsive to said pitch codebook parameters for producing a pitch codevector;

c) an innovative codebook responsive to said innovative codebook parameters for producing an innovative codevector;

d) a combiner circuit for combining said pitch codevector and said innovative codevector to thereby produce an excitation signal; and

e) a signal synthesis device including a linear prediction filter for filtering said excitation signal in relation to said linear prediction filter coefficients to thereby produce a synthesized

wideband signal, and an oversampler responsive to said synthesized wideband signal for producing an over-sampled signal version of the synthesized wideband signal;

the improvement a high-frequency content recovering device comprising:

- i) a random noise generator for producing a noise sequence having a given spectrum;
- ii) a spectral shaping unit for shaping the spectrum of the noise sequence in relation to linear prediction filter coefficients related to said down-sampled wideband signal; and
- iii) a signal injection circuit for injecting said spectrally-shaped noise sequence in said over-sampled synthesized signal version to thereby produce said full-spectrum synthesized wideband signal.

Claim 77 (Previously Presented): A decoder for producing a synthesized wideband signal as defined in claim 76, wherein said random noise generator comprises a random white noise generator for producing a white noise sequence whereby said spectral shaping unit produces a spectrally-shaped white noise sequence.

Claim 78 (Previously Presented): A decoder for producing a synthesized wideband signal as defined in claim 77, wherein said spectral shaping unit comprises:

- a) a gain adjustment module, responsive to said white noise sequence and a set of gain adjusting parameters, for producing a scaled white noise sequence;
- b) a spectral shaper for filtering said scaled white noise sequence in relation to a bandwidth expanded version of the linear prediction filter coefficients to produce a filtered scaled white noise sequence characterized by a frequency bandwidth generally higher than a frequency bandwidth of said over-sampled synthesized signal version; and
- c) a band-pass filter responsive to said filtered scaled white noise sequence for producing a band-pass filtered scaled white noise sequence to be subsequently injected in said over-sampled synthesized signal version as said spectrally-shaped white noise sequence.

Claim 79 (Currently Amended): A decoder for producing a synthesized wideband signal as defined in claim 78, further comprising:

- a) a voicing factor generator responsive to said adaptive pitch and innovative codevectors for calculating a voicing factor for forwarding to said gain adjustment module;
- b) an energy computing module responsive to said excitation signal for calculating an excitation energy for forwarding to said gain adjustment module; and
- c) a spectral tilt calculator responsive to said synthesized signal for calculating a tilt scaling factor for forwarding to said gain adjustment module;

wherein said set of gain adjusting parameters comprises said voicing factor, said excitation energy, and said tilt scaling factor.

Claim 80 (Currently Amended): A decoder for producing a synthesized wideband signal as defined in claim 79, wherein said voicing factor generator comprises a means for calculating said voicing factor  $rv$  using the relation:

~~$$rv = (E_v - E_c) / (E_v + E_c)$$~~

where  $E_v$  is the in relation to an energy of a gain-scaled version of the pitch codevector and  $E_e$  is the an energy of a gain-scaled version of the innovative codevector.

Claim 81 (Currently Amended): A decoder for producing a synthesized wideband signal as defined in claim 79, wherein said gain adjustment module comprises a means for calculating an energy scaling factor using the relation:

$$\text{Energy scaling factor} = \frac{\sqrt{\sum_{n=0}^{N-1} u'^2(n)}}{\sqrt{\sum_{n=0}^{N-1} w'^2(n)}}, n=0, \dots, N-1,$$

where  $w'$  is said in relation to the white noise sequence,  $u'$  is and an enhanced excitation signal derived from said excitation signal,  $N'$  is a length of the white noise sequence and  $N$  is a subframe length.

Claim 82 (Currently Amended): A decoder for producing a synthesized wideband signal as defined in claim 79, wherein said spectral tilt calculator comprises a means for calculating said tilt scaling factor  $gt$  using the relation:

~~gt = 1 tilt bounded by  $0.2 \leq \text{gt} \leq 1.0$~~

~~where tilt is a tilt factor given by :~~

$$tilt = \frac{\sum_{n=1}^{N-1} s_h(n)s_h(n-1)}{\sum_{n=0}^{N-1} s_h^2(n)}$$

~~conditioned by  $\text{tilt} \geq 0$  et  $\text{tilt} \geq rv$ ,~~

wherein  $S_h$  is in relation to the synthesized signal,  $r_v$  is and the voicing factor,  $N$  is a subframe length and  $n=0, \dots, N-1$ .

**Claim 83 (Cancelled):**

Claim 84 (Previously Presented): A decoder for producing a synthesized wideband signal as defined in claim 78, wherein said band-pass filter comprises a frequency bandwidth located between 5.6 kHz and 7.2 kHz.

Claim 85 (Previously Presented): A cellular communication system for servicing a geographical area divided into a plurality of cells, comprising:

- a) mobile transmitter/receiver units;
- b) cellular base stations respectively situated in said cells;
- c) a control terminal for controlling communication between the cellular base stations;







Claim 89 (Currently Amended): A cellular communication system as defined in claim 88, wherein said voicing factor generator comprises a means for calculating said voicing factor  $rv$  using the relation:

~~$$r_v = (E_v - E_c) / (E_v + E_c)$$~~

where  $E_v$  is the in relation to an energy of a gain-scaled version of the pitch codevector and  $E_e$  is the an energy of a gain-scaled version of the innovative codevector.

**Claim 90 (Currently Amended):** A cellular communication system as defined in claim 88, wherein said gain adjustment module comprises a means for calculating an energy scaling factor using the relation:

$$\text{Energy sealing factor} = \frac{\sqrt{\sum_{n=0}^{N'-1} u'^2(n)}}{\sqrt{\sum_{n=0}^{N'-1} w'^2(n)}}, n = 0, \dots, N'-1,$$

where  $w'$  is said in relation to the white noise sequence,  $u'$  is and an enhanced excitation signal derived from said excitation signal,  $N'$  is a length of the white noise sequence and  $N$  is a subframe length.

Claim 91 (Currently Amended): A cellular communication system as defined in claim 88, wherein said spectral tilt calculator comprises a means for calculating said tilt scaling factor  $g$ , using the relation:

~~$g_r = 1$  tilt bounded by  $0.2 \leq g_r \leq 1.0$~~

~~where *tilt* is a tilt factor given by:~~

$$tilt = \frac{\sum_{n=1}^{N-1} s_h(n)s_h(n-1)}{\sum_{n=0}^{N-1} s_h^2(n)}$$

conditioned by  $tilt \geq 0$  et  $tilt \geq r_v$ ;

wherein  $S_h$  is in relation to the synthesized signal,  $r_v$  is and the voicing factor,  $N$  is a subframe length and  $n=0, \dots, N-1$ .

Claim 92 (Cancelled):

Claim 93 (Previously Presented): A cellular communication system as defined in claim 87, wherein said band-pass filter comprises a frequency bandwidth located between 5.6 kHz and 7.2 kHz.

Claim 94 (Previously Presented): A mobile transmitter/receiver unit comprising:

a receiver including a receiving circuit for receiving a transmitted encoded wideband signal and a decoder for decoding the received encoded wideband signal, said decoder comprising:

i) a signal fragmenting device for receiving an encoded version of a wideband signal previously down-sampled during encoding and extracting from said encoded wideband signal version at least pitch codebook parameters, innovative codebook parameters, and linear prediction filter coefficients;

ii) a pitch codebook responsive to said pitch codebook parameters for producing a pitch codevector;

iii) an innovative codebook responsive to said innovative codebook parameters for producing an innovative codevector;

iv) a combiner circuit for combining said pitch codevector and said innovative codevector to thereby produce an excitation signal;



c) a band-pass filter responsive to said filtered scaled white noise sequence for producing a band-pass filtered scaled white noise sequence to be subsequently injected in said over-sampled synthesized signal version as said spectrally-shaped white noise sequence.

Claim 97 (Currently Amended): A mobile transmitter/receiver unit as defined in claim 96, further comprising:

a) a voicing factor generator responsive to said ~~adaptive~~ pitch and innovative codevectors for calculating a voicing factor for forwarding to said gain adjustment module;

b) an energy computing module responsive to said excitation signal for calculating an excitation energy for forwarding to said gain adjustment module; and

c) a spectral tilt calculator responsive to said synthesized signal for calculating a tilt scaling factor for forwarding to said gain adjustment module;

wherein said set of gain adjusting parameters comprises said voicing factor, said excitation energy, and said tilt scaling factor.

Claim 98 (Currently Amended): A mobile transmitter/receiver unit as defined in claim 97, wherein said voicing factor generator comprises a means for calculating said voicing factor  $r_v$  ~~using the relation:~~

$$r_v = (E_v - E_e) / (E_v + E_e)$$

where  $E_v$  is the in relation to an energy of a gain-scaled version of the pitch codevector and  $E_e$  is the an energy of a gain-scaled version of the innovative codevector.

Claim 99 (Currently Amended): A mobile transmitter/receiver unit as defined in claim 97, wherein said gain adjustment module comprises a means for calculating an energy scaling factor ~~using the relation:~~

$$\text{Energy scaling factor} = \frac{\sqrt{\sum_{n=0}^{N'-1} u'^2(n)}}{\sqrt{\sum_{n=0}^{N'-1} w'^2(n)}}, n=0, \dots, N'-1,$$

where  $w'$  is said in relation to the white noise sequence,  $u'$  is and an enhanced excitation signal derived from said excitation signal,  $N'$  is a length of the white noise sequence and  $N$  is a subframe length.

Claim 100 (Currently Amended): A mobile transmitter/receiver unit as defined in claim 97, wherein said spectral tilt calculator comprises a means for calculating said tilt scaling factor  $g_r$  using the relation:

$$g_r = 1 - \text{tilt} \quad \text{bounded by } 0.2 \leq g_r \leq 1.0$$

where  $\text{tilt}$  is a tilt factor given by:

$$\text{tilt} = \frac{\sum_{n=1}^{N-1} s_h(n)s_h(n-1)}{\sum_{n=0}^{N-1} s_h^2(n)}$$

conditioned by  $\text{tilt} \geq 0$  et  $\text{tilt} \geq r_v$ ,

wherein  $s_h$  is in relation to the synthesized signal,  $r_v$  is and the voicing factor,  $N$  is a subframe length and  $n=0, \dots, N-1$ .

Claim 101 (Cancelled):

Claim 102 (Previously Presented): A mobile transmitter/receiver unit as defined in claim 96, wherein said band-pass filter comprises a frequency bandwidth located between 5.6 kHz and 7.2

kHz.

Claim 103 (Previously Presented): A communication network element comprising:

a receiver including a receiving circuit for receiving a transmitted encoded wideband signal and a decoder as recited in claim 67 for decoding the received encoded wideband signal.

Claim 104 (Previously Presented): A communication network element as defined in claim 103, wherein said random noise generator comprises a random white noise generator for producing a white noise sequence whereby said spectral shaping unit produces a spectrally-shaped white noise sequence.

Claim 105 (Previously Presented): A communication network element as defined in claim 104, wherein said spectral shaping unit comprises:

a) a gain adjustment module, responsive to said white noise sequence and a set of gain adjusting parameters, for producing a scaled white noise sequence;

b) a spectral shaper for filtering said scaled white noise sequence in relation to a bandwidth expanded version of the linear prediction filter coefficients to produce a filtered scaled white noise sequence characterized by a frequency bandwidth generally higher than a frequency bandwidth of said over-sampled synthesized signal version; and

c) a band-pass filter responsive to said filtered scaled white noise sequence for producing a band-pass filtered scaled white noise sequence to be subsequently injected in said over-sampled synthesized signal version as said spectrally-shaped white noise sequence.

Claim 106 (Currently Amended): A communication network element as defined in claim 105, further comprising:

a) a voicing factor generator responsive to said ~~adaptive~~ pitch and innovative codevectors for calculating a voicing factor for forwarding to said gain adjustment module;











Claim 118 (Currently Amended): A bidirectional wireless communication sub-system as defined in claim 115, wherein said spectral tilt calculator comprises a means for calculating said tilt scaling factor  $g$ , using the relation:

~~$g_f = 1$  tilt bounded by  $0.2 \leq g_f \leq 1.0$~~

~~where *tilt* is a tilt factor given by :~~

$$tilt = \frac{\sum_{n=1}^{N-1} s_h(n)s_h(n-1)}{\sum_{n=0}^{N-1} s_h^2(n)}$$

~~conditioned by  $tilt \geq 0$  et  $tilt \geq r_v$ ,~~

wherein  $S_k$  is in relation to the synthesized signal,  $r_v$  is and the voicing factor,  $N$  is a subframe length and  $n=0, \dots, N-1$ .

**Claim 119 (Cancelled):**

Claim 120 (Previously Presented): A bidirectional wireless communication sub-system as defined in claim 114, wherein said band-pass filter comprises a frequency bandwidth located between 5.6 kHz and 7.2 kHz.

**Claim 121 (Cancelled):**

Claim 122 (Previously Presented): A high-frequency content recovering method as defined in claim 64, wherein said spectral shaping of the noise sequence comprises filtering the noise sequence in relation to a bandwidth expanded version of the linear prediction filter coefficients to produce a filtered noise sequence characterized by a frequency bandwidth generally higher than a frequency bandwidth of the over-sampled synthesized signal version.

Claim 123 (Previously Presented): A decoder for producing a synthesized wideband signal as defined in claim 67, wherein said spectral shaping unit comprises a spectral shaper for filtering the noise sequence in relation to a bandwidth expanded version of the linear prediction filter coefficients to produce a filtered noise sequence characterized by a frequency bandwidth generally higher than a frequency bandwidth of the over-sampled synthesized signal version.

Claim 124 (Previously Presented): A decoder for producing a synthesized wideband signal as defined in claim 76, wherein said spectral shaping unit comprises a spectral shaper for filtering the noise sequence in relation to a bandwidth expanded version of the linear prediction filter coefficients to produce a filtered noise sequence characterized by a frequency bandwidth generally higher than a frequency bandwidth of the over-sampled synthesized signal version.

Claim 125 (Previously Presented): A cellular communication system as defined in claim 85, wherein said spectral shaping unit comprises a spectral shaper for filtering the noise sequence in relation to a bandwidth expanded version of the linear prediction filter coefficients to produce a filtered noise sequence characterized by a frequency bandwidth generally higher than a frequency bandwidth of the over-sampled synthesized signal version.

Claim 126 (Previously Presented): A mobile transmitter/receiver unit as defined in claim 94, wherein said spectral shaping unit comprises a spectral shaper for filtering the noise sequence in relation to a bandwidth expanded version of the linear prediction filter coefficients to produce a filtered noise sequence characterized by a frequency bandwidth generally higher than a frequency bandwidth of the over-sampled synthesized signal version.

Claim 127 (Previously Presented): A network element as defined in claim 103, wherein said spectral shaping unit comprises a spectral shaper for filtering the noise sequence in relation to a bandwidth expanded version of the linear prediction filter coefficients to produce a filtered noise sequence characterized by a frequency bandwidth generally higher than a frequency bandwidth of

the over-sampled synthesized signal version.

Claim 128 (Previously Presented): A bidirectional wireless communication sub-system as defined in claim 112, wherein said spectral shaping unit comprises a spectral shaper for filtering the noise sequence in relation to a bandwidth expanded version of the linear prediction filter coefficients to produce a filtered noise sequence characterized by a frequency bandwidth generally higher than a frequency bandwidth of the over-sampled synthesized signal version.